M.O. 278.

The Meteorological Magazine

Air Ministry :: Meteorological Office

Vol. 60
August 1925
No. 715

LONDON: PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE.

To be purchased directly from H.M. STATIONERY OFFICE at the following addresses: ADASTRAL HOUSE, KINGSWAY, LONDON, W.C.2; 28, ABINGDON STREET, LONDON, S.W.1; YORK STREET, MANCHESTER; 1, ST. ANDREW'S CRESCENT, CARDIFF; or 120, GEORGE STREET, EDINBURGH; or through any Bookseller.

The King's Cup Air Race

Meteorological Conditions

THE air race round Great Britain for the cup presented by H.M. the King was flown in two circuits of 804 miles a day. The flights on the first day, Friday, July 3rd, were carried out under conditions of weather which, while testing to the utmost the skill of the competitors, only served to enhance the brilliance of the performances of the four pilots who succeeded in completing the circuit.

During the week previous to the race, the predominating feature of the weather charts was an anticyclone which moved slowly across England to Scandinavia. On Thursday a depression spread eastwards over northern France resulting in an easterly wind current over the British Isles. On Friday morning the south-east of England, under the influence of the depression over northern France, was overcast with low clouds from which slight rain fell intermittently. North of London conditions were even worse. Stations on the east and north-east coasts reported fog, while further inland there were banks of very low cloud which enveloped most of the eastern half of England. Both these phenomena could be traced to the same cause; an influx of warm air drifting across the North Sea from the Continent. Under these conditions the fog on the coast is readily explained but it is a little remarkable that it extended so far inland where it appeared as low cloud owing, doubtless, to the greater turbulence at the surface of the ground.

Wt 69—P 1 1000 8/25 M & C

In spite of the adverse weather reports the first machines left Croydon at the scheduled time, 6 a.m. During the morning it became known that no fewer than seven of the competitors had been forced to land near the eastern flank of the Chilterns owing to low cloud. One pilot, Major Bulman, had a narrow escape in landing through the fog at Bedford. An idea of the weather conditions between Croydon and Newcastle can be obtained from the following account by Captain F. Tymms, who accompanied Major Hemming as navigator on a D.H.37 machine.

"Just north of Watford visibility decreased to about 100 yards and the cloud base was found to touch the ground. We therefore climbed through the cloud, emerging from the bottom layer at about 2,000 feet. Another layer of cloud, mainly alto-stratus and alto-cumulus, was found above us. After climbing to 8,000 feet, the height of this upper layer was estimated to be between 10,000 and 12,000 feet. Between the two layers haze, which thickened as we flew northwards, prevented the formation of a clear horizon, thus increasing the pilot's difficulty in keeping the machine on a steady course and an even keel. Shortly after 9 o'clock, when we were north-west of Leicester, the upper layer of clouds cleared and the haze disappeared. At 9.18 some distance to the westward, we found a hole a few miles across, and seeing that the top layer of clouds and the haze recommenced to the northward, we decided to go down in order to verify our position and to see whether it was possible to fly underneath the bottom layer. We shortly afterwards ran into light rain, and while steering north-east to get back to the low country over Lincolnshire we were forced down by the low cloud into a valley and landed north of Derby at 9.40.

"It was 12 o'clock before the clouds lifted sufficiently to enable us to continue, and after getting off we found that they were still only 100 feet above the hill-tops and in some places lower. The visibility nowhere exceeded 500 yards. These conditions were experienced all the way to Harrogate. On leaving Harrogate at 1.30 we found a remarkable change. The clouds were still low (about 300 feet) but, flying beneath them, visibility was at least 20 miles. When passing Ripon the north-west shoulder of the Cleveland Hills could be seen plainly. West of Darlington visibility dropped to 200 yards and the cloud base descended. In order to pass the high ground between Darlington and Durham we had to follow the railway which passes through a gap at Ferry hill. At that time the visibility was only 100 yards. Over the lower country between Durham and Newcastle visibility improved owing the the greater height of the cloud base above the ground." It is worthy of note that both Major Hemming and Captain Tymms have expressed the opinion that,

had their machine been fitted with a twin indicator, they would have been able to continue their course above the lower cloud layer till they were east of Harrogate, and in view of the conditions actually prevailing at Harrogate at the time they would then have been able to land at the aerodrome, thus completing the first stage of the flight without having made a forced landing.

The unpleasant conditions of low cloud and poor visibility extended further west over the Cheviots, but in the west of Scotland the cloud layer was broken and visibility improved. From Renfrew to Sealand, conditions were rather better, visibility being as much as 10 miles in places. Haze, however, occurred locally. Over southern England low cloud persisted throughout the day apart from a partial temporary lifting in places during the afternoon. Thunderstorms were experienced by the competitors along the last stage of the flight between Bristol and Croydon. Captain Tymms stated that they encountered a thunderstorm over the Marlborough Downs with heavy rain and clouds on the tops of the hills. A second thunderstorm was encountered east of Newbury, and during this period the light failed to such an extent that it was scarcely possible to see the compass or maps.

Captain F. L. Barnard, flying a Siskin V, was the first pilot to reach Croydon. Great credit is due not only to him but to the pilots of the other three machines who completed the circuit under conditions which, from the point of view of aviation, could hardly have been worse.

On Saturday, July 4th, when the same course was followed, but in the opposite direction, there was a general all-round improvement in the weather, no phases of it calling for special comment. Of the four pilots who completed the circuit the previous day, three started on Saturday, Mr. Hinkler having withdrawn from the race. The first home and winner of the race was Captain F. L. Barnard, Squadron Leader Jones and Major Hemming following. The overall average speed of the winning machine was 130 m.p.h. on the first day and 151 m.p.h. on the second. The fact that such speeds were maintained over a difficult course and with extremely adverse weather conditions speaks very highly for the skill and courage of the pilots and the excellence of the work of the aircraft industry. It is striking proof of the great advance made in aviation in this country in recent years.

A special race was organised on Saturday over a shorter course for those competitors who were unfortunate enough to have to withdraw from the main race owing to the adverse weather of the previous day. The "Croydon Stakes," as this race was named, was won by Colonel the Master of Sempill.

F.E.

Amundsen's Polar Flight

MANY proposals have been made for a flight to the North Pole and a possible survey of the polar regions from airships or aeroplanes, but the first real attempt in this direction was made this summer by Captain R. Amundsen.

From a meteorological standpoint the flight possessed considerable interest owing to the small amount of reliable information in existence regarding weather conditions in the regions farthest north. For a number of years weather observations have been made at the Norwegian radio station in Green Harbour, Isafjord, on the west side of Spitsbergen, while information also exists regarding weather conditions over Jan Mayen and Bear Island. There are in addition a few stations on the Russian and Siberian Arctic coasts and also at Nome and Pt. Barrow, Alaska. A series of different expeditions has given information regarding the weather on some of the other Arctic Islands but the far north is largely unexplored country from a meteorological point of view. The Fram expedition (1894-6) was the only one to draw up complete data for the Arctic Ocean.

In considering the different meteorological elements which may affect flying in these regions the data obtained from Spitsbergen, the starting point for this flight, indicated that May was the most suitable month for the flight. The wind at all times of the year has a low mean speed with a marked seasonal change from south-east or south in summer to north or north-west in winter. Gales are exceptional, while cloud amounts are generally less in winter and early spring than in other parts of the year. The lowest monthly total of rainfall and the smallest number of days of precipitation occur in May or June. The factor most troublesome for aviation in the polar regions, however, is the prevalence of low-lying banks of fog in the summer. For all practical purposes fogs are absent from the end of September until the beginning of May but there is a steadily increasing frequency from the beginning of May until the middle of July. The Fram expedition obtained a value as high as 36 % for days of fog in the Arctic Ocean for mid-July.

For Amundsen's flight two Dornier Wal flying boats (each fitted with two Rolls Royce Eagle engines) were used and each machine carried a pilot, a navigator and a mechanic. At the time of departure from King's Bay, Spitsbergen, an anticyclone was spreading northwards from Iceland and had just extended its influence over Spitsbergen. At 5 p.m. on May 21st, when the flight commenced, very favourable weather conditions prevailed—a calm, exceptional visibility, and a sky only three-tenths covered with cloud, the base of which was above 2,000 feet. Fog was encountered at Sydgat and the machines flew above this for two hours, eventually leaving it behind an hour

later. Both machines landed about latitude 88°N. in order to obtain accurate bearings, but the ice conditions were such that they were unable to proceed farther north, and over three weeks were spent here before any further progress could be made. Little change occurred in the pressure distribution for the first few days after the machines had left, but at Spitsbergen itself within two days the weather deteriorated and occasional rain, sleet or snow was encountered. Little news is at present available of the weather conditions experienced by the exploration party after the landing. The return was made on June 15th with all the members on one machine. Fog was again encountered but Spitsbergen was reached in safety.

To give the expedition a better chance of making the flight under the best conditions it is understood that additional observations were obtained from the meteorological stations in high latitudes and that Dr. J. Bjerknes was in Spitsbergen to advise regarding the weather conditions. While one cannot but admire the personal courage involved in such an undertaking as this, one must confess that very little information of meteorological value can be obtained from an isolated flight. In such a case it is difficult to decide if the weather phenomena which may be encountered are normal to the district or of an exceptional nature.

Captain R. Amundsen on his return has expressed himself against the possibility of a successful polar expedition by aeroplane owing to the exceptionally difficult conditions for landing on and taking off from the ice fields. While one must respect this view, there is the incentive that one flight which was not quite successful has a tendency to lead to others which ultimately attain their objective and perhaps to a regular service of aircraft, heavier or lighter than air. Before such a service can eventuate, however, much more meteorological information regarding the polar regions will be required.

R.S.R.

OFFICIAL PUBLICATION

The following publication has recently been issued :—

Advisory Committee on Atmospheric Pollution. Tenth Annual Report ; for the year ending March 31st, 1924.

The Committee for the Investigation of Atmospheric Pollution was appointed by a conference of delegates of municipal authorities and others held in connection with the Smoke Abatement Exhibition in 1912. With the issue of the present Report, which covers the year ending March 31st, 1924, the Committee thus completed the twelfth year of its activity. The primary objects

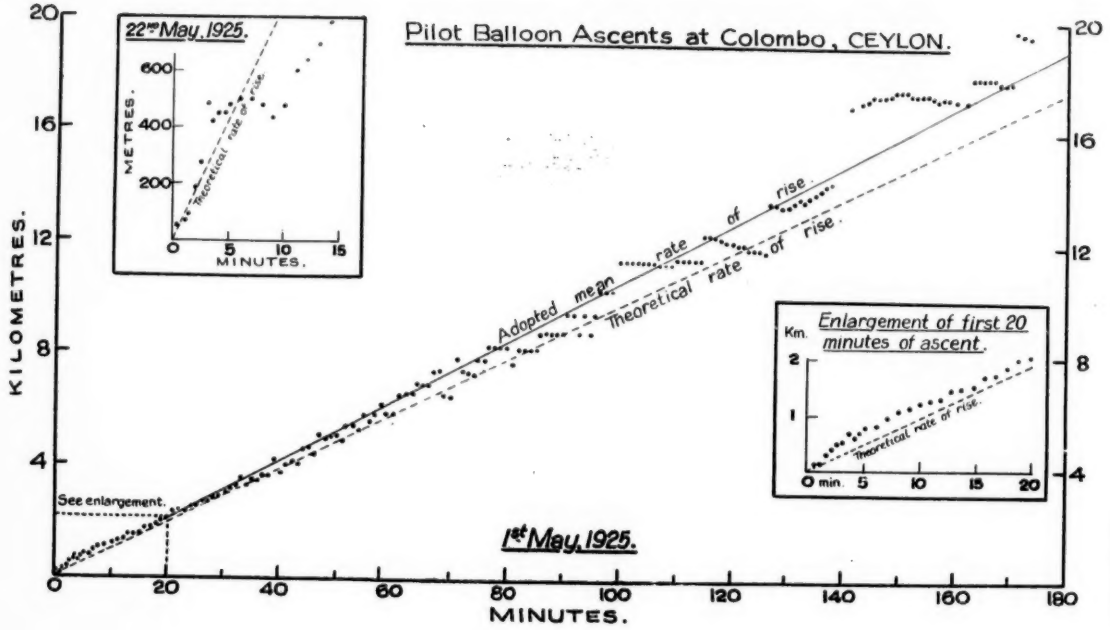
of the Committee are the systematic measurement and analysis of atmospheric impurity and the collection of a body of suitable data for the solution of various problems affecting the purity of the air in which we live and, in consequence, the health of the community.

Following a short Introduction and Summary of the year's operations, the Report is divided into eight sections. Three of these sections deal with the results obtained by what is known as the Standard Deposit Gauge, the primary function of which is to collect deposited impurity so as to compare the measurements of the amounts which fall in different localities, the Automatic Filter which measures hourly the amount of impurity suspended in the air, and the Jet Dust Counter which allows a microscopic examination of dust particles and their number to be made. The remaining sections deal with aspects of the work which are in an experimental stage as well as observations which are of especial interest in connection with the study of atmospheric pollution. In the former class may be mentioned the researches on the visibility of distant objects as affected by atmospheric pollution, and spectographic analysis of suspended impurities, in the latter class, the discussion of the darkness of Wednesday, January 23rd, 1924, and of the distribution of dust in the vertical based on observations by Dr. Kimball of the United States Weather Bureau.

We learn from the Report that the air was not as pure as in the previous year. At Blackburn and Stoke-on-Trent the diurnal distribution of atmospheric pollution is broadly similar to that found in other cities with a maximum in the forenoon. An important peculiarity of the Blackburn curves is the rapid rise of impurity which commences about 4 a.m. in the summer and reaches its maximum on week-days and Saturdays at 7 a.m., while on Sundays the maximum is not reached until 10 a.m.

A description is given of a new instrument, the Settlement Dust Counter, designed by Dr. Owens, for measuring the amount of dust particles or bacteria in the air even when such dust particles are very coarse as in grain warehouses and similar places.

About 19h. 40m. towards the end of a thunderstorm on July 27th, Mr. H. J. E. Dobson observed at Norwood a vivid white globe of about 18 in. diameter (flattened at the top) which appeared to be moving rapidly towards an earthed aerial wire. The globe was about 18 ft. above the ground and burst about 1 second after its first appearance. The explosion was preceded by a sizzling noise and according to another observer was accompanied by a violet tinged flash.


Pilot Balloon Ascents at Colombo, CEYLON.
22nd May, 1925.
METRES.
600
400
200
0
5
10
15
MINUTES.
Theoretical rate of rise.
Adopted mean rate of rise
Theoretical rate of rise.
Enlargement of first 20 minutes of ascent.
Km.
2
1
0 min.
5
10
15
20
Theoretical rate of rise.
See enlargement.
1st May, 1925.
KILOMETRES.
20
16
12
8
4
0
20
40
60
80
100
120
140
160
180
MINUTES.

to face p. 103

Correspondence

To the Editor, *The Meteorological Magazine*

Pilot Balloon Ascents at Colombo, Ceylon

Two recent flights at Colombo may be of interest, as illustrating the value of tail observations with one-theodolite flights.

The first shows that these observations may be of considerable value, even at very high altitudes. A balloon, released at 14h. 44m. on May 1st, 1925, was observed by Mr. H. T. de Silva, for 173 minutes, the estimated final height being over 18 km. The balloon was finally lost behind low cloud, while still visible without great difficulty. This is the longest and highest flight yet observed at Colombo.

The length of a 20 metre tail (with a pendant at 5 metres, for use at the commencement of the flight) was estimated at each minute, and, for the first five minutes, at each half-minute, by comparison with a graticule of spider webs at the focus of the eye-piece. The height was computed graphically for each tail observation, and these heights were plotted as ordinates against the time. In this case the computed heights were adopted up to the 20th minute, except that those at $3\frac{1}{2}$, 6, 12, 16, 19 minutes were smoothed, while from the 20th minute to the end of the flight a mean rate of 106 m/min. was deduced from the tail observations, the theoretical rate, on the formula, $V=81\ L^{\frac{1}{2}}/(W+L)^{\frac{1}{2}}$, being 97. This is shown by a dotted line on the graph.

While an error in the grid, or personal equation in estimating, might cause fairly large errors in the absolute rate of rise deduced from these observations, yet the graph leaves no doubt that the balloon was rising fairly uniformly throughout. Without it, one might not have been sure that the balloon was not descending in the latter part of the flight, and could certainly not have affirmed that the rate of rise had not altered so much as to invalidate the velocities deduced.

In this connection it may be worth mentioning that there has been noted here a general tendency for the rate of rise of the balloons, measured in this way, to increase after a height of some six kilometres or so is reached. This increase is not particularly noticeable on the graph for May 1st, but in many cases is quite well marked. A possible explanation is that it is due to a tendency to underestimate apparent tail-lengths, when these are only a fraction of one interval of the comparison grid. It has been noticed with four separate observers, of different ages and races (Messrs. Bamford, Dassanayake, De Silva, and myself) so can hardly be explained as a personal equation, but might be due to a general tendency to underestimate in such observations. The point may perhaps be settled by a statistical investigation as to whether the change tends to set in at a

definite altitude, or at a definite apparent tail-length, and this investigation has now been started.

Should the psychological explanation prove insufficient, the phenomenon may be due either to actual convection effects in the upper air over Colombo or to a tendency for the balloons to rise faster at greater altitudes, owing to the diminishing air resistance more than counterbalancing the loss of pull from leakage. The facts that the change of rate is, in spite of the inaccuracy of individual observations, frequently noticeably abrupt, and that no consistent increase in rate has been noticed below 6 kilometres, are arguments against the latter view.

The second flight, a low one, on May 22nd, apparently indicates a rolling type of turbulence in the lowest layers. The theoretical rate of rise is shown as a dotted line. The observed heights were taken without smoothing, except at the 3rd and 11th minutes.

H. JAMESON.

Colombo Observatory, Ceylon. May 28th, 1925.

[We welcome this letter which shows that upper air investigation is being vigorously pursued in Ceylon. To follow a pilot balloon for nearly three hours is no mean achievement. The diagrams require some comment. The horizontal rows of dots in the upper part of the ascent of May 1st suggest that the tail measurements were not sufficiently exact. For example, if everything between 7·4 and 6·5 were called 7, while 6·4 became 6, the balloon would apparently float nearly at one level for some minutes and then jump suddenly to a higher level. Some of the irregularities are possibly due to a slow swinging of the tail, and this may be the explanation of the "rolling" effect found with the ascent of May 22nd. Ed. *M.M.*]

The June Drought at Guernsey

JUNE was rainless at Guernsey. It is the first rainless month noted here since observations were begun by the late Dr. S. E. Hoskins, M.D., F.R.S., in 1843. The drought which lasted for 33 days, from May 30th to July 1st, is not, however, quite the longest on record here. In 1893, the spring and early summer of which was exceedingly dry, no rain was measured for 35 consecutive days. This drought began on March 18th, ended on April 21st, and was followed by another which, beginning on May 21st lasted for 33 days and came to an end on June 22nd.

I commenced observing in 1894, and in 1899 I registered a drought of 34 days duration (July 24th to August 26th). Although this year's drought was beaten for length in 1893 and again in 1899 the interesting fact is the occurrence of an absolutely dry month—the only one registered in 82½ years of observation.

BASIL T. ROWSWELL.

Les Blanches, St. Martin's, Guernsey. July 11th, 1925.

Sea Fog over Land

In reply to Mr. Whipple's note on "Sea Fog over Land," in the June issue of the *Meteorological Magazine*, I would like to say that I have noted the same phenomena—cloudy patches forming over bare soil or ploughed land, while the grass land adjoining remained comparatively clear—several times and that the sun need not reach the zenith for these conditions to occur, as they have been noted as early as 9 a.m.

This steaming effect, as viewed from a prominence, was particularly marked on the morning of December 16th last at Larkhill. The soil on this occasion was quite damp, and can certainly be classed as light. The wind was about 4 m.p.h. from the south-west. It is a coincidence that the pressure distribution over the south of England on this date should be very similar to that of April 11th, when Mr. Whipple's observations were made.

P. RAYMOND ZEALLEY.

Larkhill, Salisbury Plain. June 22nd, 1925.

The "Spectre of the Brocken" in Lakeland

On June 28th an ascent of Sca Fell had been made by a small party, unable to leave Keswick before a quarter to one (summer time) by cycle and motor-cycle for Seathwaite. Hence evening had well advanced as we neared Esk Hause (2,500 ft.) on the return. The others, hastening for a dip in Sprinkling Tarn, were five or ten minutes ahead and missed what follows:

Light clouds had been troublesome about the summits, but these were now beautifully clear. Instead clouds were forming on the upper valley slopes. Those in Eskdale, which drops towards south-west by south were drifting up over the Hause in fleecy tenuous streams, dissolving as a rule in falling to the pass from Sty Tarn to Angle Tarn, lying at right angles, 200 ft. below. The sun was then (8.50 p.m. summer time) still very bright, though low in the west north-west between Sca Fell Pikes and Great End.

The descent approaches Esk Hause from the west, turning then sharp north, the slope dipping gently towards the Hause. The thought struck me that the conditions for seeing the "spectre" were ideal. Told about it first in early boyhood, I never actually witnessed it. Looking, therefore, to the right on reaching the spot my expectations were amply justified. The shadow of my legs stretched along the slope to the cloud stream some 200 yards away, upon which that of my body, stick and head was seen upright. The last was the centre of a brilliant "glory" in all 7° to 10° across, as roughly estimated afterwards by comparison with the moon. Next the head came a bright circle, white with a faint ruddy tint, some 4° across and enclosed in a dark blue ring nearly ½° wide. Another light

ring, but yellowish, 1° to 1½° wide, separated this from a red ring, ¾° wide. Beyond it at times and slightly separated from the red, were right and left arcs of a second blue ring. The inner circle and blue ring were complete. Arcs of the others rested on the ground like those of a rainbow. The "spectre" itself mocked my movements in orthodox fashion. The whole waxed and waned as the density of the fleecy clouds increased or decreased. It still persisted, accompanying me awhile down the slope, when at nine I had perforce to continue my descent. I wished I retained sufficient knowledge of optics to understand precisely how the phenomenon is formed.

J. EDMUND CLARK.

41, *Downscourt Road, Purley, Surrey. July 1st, 1925.*

[An explanation of how the Brocken Spectre is formed, is to be found in the Dictionary of Applied Physics, Vol. III., p. 527, § (15). It was so named from having been first observed in 1780 on the Brocken, Germany. Ed. *M.M.*]

An Unusual Lunar Eclipse

AT 11 p.m. on February 20th, 1924, there was an eclipse of the moon, which was witnessed at Kroh in Upper Perak (Malay Peninsula). At the time the British Squadron was cruising, and I hoped that there would be a report, but the incident seems never to have been noticed. I give now the account as I wrote it down in my journal at the time and I should be very glad to have an explanation of the phenomenon, if possible.

"20th Feb. 1924. This evening we witnessed a most extraordinary eclipse of the moon. It began normally, with a well-defined shadow, but half an hour later at 10.45 p.m. a vague smoky shadow, irregular in shape, and with no defined border, filled in the centre of the moon's disc. The brighter edges of the moon round the shadow were angry orange, as if light were passing through a smoke or vapour. (It occurred to me at the time there might have been a volcanic outburst in Java, but this was not the case). At 11.30 p.m. a new and mysterious phase set in, most amazing to watch. Though the sky was completely fine, the full moon came and went, as if it were being crossed by scudding clouds. Often it was completely blotted out, not even a halo being visible, though the adjacent stars were shining as usual. The moon kept reappearing with varying brightness, only to disappear again into complete darkness for as much as half a minute at a time."

My regiment was in camp at the time. The phenomenon was witnessed by several other officers. Two said they had noticed an unusually fine sunset, though I had not done so.

C. M. ENRIQUEZ.

Taiping, Federated Malay States. May 3rd, 1925.

[The total phase of this eclipse in Perak lasted from approximately 10h. 20m. to 11h. 57m. (Zone Time) and the moon's altitude was high, about 85° at the end of totality. The observation of a central dusky area encompassed by a more luminous orange ring is quite usual during an eclipse and arises from the grouping of the maria on the moon's surface. The brilliancy of the eclipsed moon depends upon the quantity of light refracted through a ring of the earth's atmosphere lying round the great circle where, at the moment under consideration, the sun is on the horizon. The moon is invisible in some eclipses and relatively bright in others, but usually it is quite a conspicuous object. These differences have been explained as due to variations in the amount of refracted light, owing to different conditions of cloudiness, amount of aqueous vapour present, etc., but the subject has apparently never been quantitatively treated. Major Enriquez's observation of the rapid variation of brilliancy during the course of an eclipse is very interesting. On one occasion (October 13th, 1837) Sir John Herschel saw "various and changeable distributions of light" and one or two other observers have noted varying colours during the progress of an eclipse, but a definite observation of rapid changes does not appear to have been previously put on record.—ED. *M.M.*].

Thunder Coming Up Against the Wind

ABOUT 9 p.m. on the evening of July 22nd, after a violent thunderstorm had passed over this district, I encountered a striking, and in the circumstances, useful illustration of the principle that a thunderstorm is frequently observed to come up against the surface wind. I was standing on the edge of Hampstead Heath undecided as to whether it would be safe to venture very far with nothing but the undesirable shelter of trees in the event of a renewal of the storm; for the sky, still overcast, gave no clue which I could recognise as to whether it would prove merely the leaden aftermath that so often follows a thunderstorm or whether it would speedily thicken and darken again with the advance of a fresh storm drifting over in the warm and humid south east current prevailing at the time. I had just made up my mind to take the risk when I became aware of a very decided surface wind moving from the north, that is to say from the direction of the retreating storm and against the general south-east drift in which the clouds were moving. This, I argued, pointed to the existence of another thunder system to the south, which was apparently drawing in this northerly surface breeze, and which would probably soon arrive from the south, even though there were not at the moment any other decided indications thereof. Within half an hour there

was a renewal of torrential rain and violent thunder and lightning.

L. C. W. BONACINA.

27, Tanza Road, Hampstead, N.W.3. July 24th, 1925.

NOTES AND QUERIES

The Thunderstorms and heavy Hail Showers over south-east England on July 22nd, 1925

EXCEPTIONALLY heavy falls of hail accompanied one of the series of violent thunderstorms that occurred on the afternoon and evening of July 22nd, and caused much damage, breaking innumerable windows and even penetrating slate roofs. The heaviest hail fell shortly after 17h. G.M.T., and lasted nearly 10 minutes, irregular lumps of ice slightly exceeding two inches in diameter falling in the region extending from Woolwich and East Ham eastwards to Dartford and northwards to Romford, *i.e.*, in a strip of country fully 8 to 12 miles across. The pieces of ice were evidently conglomerations of many separate hail-stones. There was preliminary thunder and lightning, which ceased during the fall of hail.

Destructive winds occurred at Ashford (south-east Kent), and on both sides of the Thames Estuary (at Sittingbourne and Shoeburyness); also in Cambridgeshire and Huntingdonshire. The latter accompanied the passage of a thunderstorm between 19h. and 20h. Funnel-shaped tornado-like clouds were observed at Shoeburyness and also in Cambridge and Great Chesterford (12 miles south south-east of Cambridge).

The thunderstorms under discussion had been preceded by others a day earlier. During that time there was a depression over the Bay of Biscay and western France, which deepened on the 22nd, while moving north to the western part of the Channel. Surface winds were mainly easterly over eastern England, and at noon there was a rapid increase and veer of wind with height as the following figures show:

Height.	Cranwell 10h. G.M.T.		S. Farnborough 12h. G.M.T.		Lympne 11h. G.M.T.	
	Direction.	Speed.	Direction.	Speed.	Direction.	Speed.
(ft.)	(°)	(m.p.h.)	(°)	(m.p.h.)	(°)	(m.p.h.)
Surface.	45	9	130	8	125	6
1,000	60	9	110	11	115	17
4,000	130	37	105	30	155	35
6,000	130	44	155	39	160	61
10,000	—	—	155	50	160	55

These changes of wind with height would lead one to expect a big horizontal gradient of temperature in an east to west direction, such as the following figures show to have existed :

Height.	Duxford (Cambridge) 8h. G.M.T.	Utrecht 7h. G.M.T.
(ft.)	(°F.)	(°F.)
1,000	66	80
4,000	64	72
10,000	45	46
15,000	25	31

Violent squalls accompanied the thunderstorms at Shoeburyness 53 m.p.h. from WSW, and at Cambridge up to 45 m.p.h. from S, but, although sudden falls of temperature occurred, these were probably not of the " line-squall " type. The general drift of the storms was from south to north, with the upper wind current, but winds from nearly every direction appear to have occurred in the lower layers, and so many thunderstorms occurred, over so large an area, that very detailed information would be necessary to correlate the different phenomena just described.

At Hampstead Observatory 47 mm. of rain fell in the 24 hours ending on the morning of the 23rd, and at Barking 44 mm.

E. V. NEWNHAM.

On the evening of Wednesday, July 22nd, 1925, the Woolwich and Plumstead district was visited by a very severe thunderstorm, extensive damage being caused by a heavy downpour of hail. Shortly after 17h. G.M.T. lightning followed by very loud thunder overhead was the signal for the commencement of the storm. Rain and hail began to fall, the hailstones increasing in size till within five minutes several were as large as a man's fist and weighed over 8 ounces. These large pieces of hail consisted of a white opaque centre surrounded by jagged ice crystals. An interesting specimen which was shaped like an oyster shell consisted of a number of small hailstones cemented around the white opaque centre. A large number of skylights and windows facing south were broken, and in a few instances slated roofs were penetrated. The fall of hail lasted for 12 minutes and was followed by torrential rain until 17h. 30m. G.M.T., when the storm temporarily ceased. Thunder and lightning accompanied by heavy rain continued at intervals for several hours, but no more hail fell.

Drainage arrangements were quite inadequate to cope with the rainfall, some of the lower roads were flooded and the water reached a depth of 3 feet in one of the roads adjoining the Plumstead Marshes.

G. A. LIVETT.

Radiation from the Sky

RADIATION MEASURED AT BENSON, OXON, 1925.

Unit: one gramme calorie per square centimetre per day.

		April	May	June
ATMOSPHERIC RADIATION only (dark heat rays). Averages for Readings				
Cloudless days:—				
Number of readings	n	9	8	17
Radiation from sky in zenith ...	π I	468	524	579
Total radiation from sky ...	J	503	564	617
Total radiation from horizontal black surface on earth ...	X	741	769	809
Net radiation from earth ...	X—J	238	205	192
DIFFUSE SOLAR RADIATION (luminous rays). Averages for Readings between 9 h. and 15 h. G.M.T.				
Cloudless days:—				
Number of readings	n_0	3	1	4
Radiation from sky in zenith ...	πI_0	64	98	80
Total radiation from sky ...	J_0	73	101	69
Cloudy days:—				
Number of readings	n_1	1	2	3
Radiation from sky in zenith ...	πI_1	160	122	140
Total radiation from sky ...	J_1	114	116	139

Unit for I = gramme calorie per day per steradian per square centimetre.

Unit for J and X = gramme calorie per day per square centimetre.

For description of instrument and methods of observation, see *The Meteorological Magazine*, October, 1920, and May, 1921.

Meteorological Exhibit at the Highland and Agricultural Society's Show at Glasgow, July 14th to 17th, 1925

THE Meteorological Office Exhibit was housed in the pavilion of the Board of Agriculture for Scotland. Diagrams, instruments and publications were shown, but the feature which attracted most interest was the demonstration of weather forecasting. Weather charts were drawn each day and the local Daily Weather Reports ordinarily produced at, and circulated from Renfrew Aerodrome were prepared and duplicated at the pavilion, including copies for distribution in Glasgow. The process was closely watched by a large number of spectators. Duplicated charts were exhibited outside the pavilion and in

other parts of the Show. The assistance of Professor G. W. O. Howe of the Electrical Engineering Department of Glasgow University and of Mr. D. Roberts and Mr. Craigie of the Radio Communication Company, who rendered valuable services in connexion with the wireless arrangements for the reception of the synoptic reports, is gratefully acknowledged. The press generally made favourable comments on the meteorological exhibit.

Many of the Scottish farmers present expressed their appreciation of the quality and usefulness of the forecasts issued by the Meteorological Office through the British Broadcasting Company.

A Floating Weather Bureau

In the *Meteorological Magazine* for May, 1923, an account was given under the above heading of the meteorological work carried out, since 1921, on board the French vessel *Jacques Cartier*, which sails between French and American ports, and is used as a training ship for cadets of the French Mercantile Marine. The meteorological work initiated by Mr. Bowie has now become a regular part of the course. During each voyage observations are collected by wireless from all ships in the neighbourhood and transmitted to land four times daily. Since November, 1924, by the use of a very short wave-length (115 m.) the meteorological messages have been transmitted direct to Paris throughout the whole voyage across the Atlantic, and actually at certain hours when the vessel was in the Pacific. The number of observations received and transmitted has steadily increased and during the last voyage averaged thirty or forty a day. These observations and those taken on board the *Jacques Cartier* itself are broadcasted to the whole of Europe in the synoptic message sent out from the Eiffel Tower. The staff do not limit themselves to receiving and transmitting the observations however, and synoptic charts are drawn twice a day from the observations received from ships and from the synoptic messages issued by Europe and America. Forecasts for the chief transatlantic routes are made from these maps and are broadcasted at stated hours for the information of the ships which have co-operated. In bad weather it is not uncommon for all other ships to fall silent when the *Jacques Cartier* transmits its forecasts. Research is not forgotten and the birth of depressions off Cape Hatteras (the "Hatteras" phenomenon) has been investigated and described in a paper communicated to the French Academy of Sciences.

The International Meteorological Committee at the meeting held in 1923, passed a resolution commending the scheme of

work and requesting ships of all nationalities to assist. The meteorological campaign of 1924-1925 ended in June; the work has been so successful and the forecasts have proved so useful to shipping that it may be hoped that the organization of a permanent floating Weather Bureau on an international basis may not be long delayed.

The Colombian Meterological Service

In July, 1920, the Republic of Colombia organised a meteorological service, under the energetic direction of the Rev. Father S. Sarasola, S.J., well-known as the founder and Director of the Observatory of Monserrat at Cienfuegos, Cuba. The headquarters of the new service were at first in the old Observatorio Nacional, but the equipment was poor and the location unsatisfactory. The headquarters were accordingly removed to the Colegio Nacional de San Bartolemé, Bogota, and a complete equipment was ordered from Europe. The new observatory which is situated at a height of over 8,000 ft. was inaugurated on September 24th, 1922. The first publication* of the new organisation has recently been received and the programme of activities which it contains holds out good promise for the future of the meteorological work in Colombia. This volume clears the way for future work by collecting the scattered information for Colombia obtained in previous years; the observations at the new observatory are to be published in annual issues, that for 1923 being just completed. Bi-hourly values from 6h. to 20h. of pressure, temperature, vapour pressure, relative humidity and wind, are given, together with daily rainfall figures and detailed cloud observations four times a day. Monthly and annual summaries of the various elements complete this excellent volume.

International co-operation is readily undertaken; observations are being contributed to the Réseau Mondial, and the new observatory plays its part in the hurricane warning service organised by the United States. We wish all success to Father Sarasola in his new home.

Tetrahedral Pilot Balloon for High Ascents

It should be possible on clear and cloudless days to follow a pilot balloon through the theodolite to great heights provided the balloon does not burst and is not lost in the distance. The latter cause may be easily minimised by giving the balloon a high free lift, but the objection against this practice is that the balloon is more likely to burst before attaining the desired

* Notas Geofisicas y Meteorologicas. No. 1 Noticia del nuevo observatorio, con algunos datos sobre la climatologia y el magnetismo de Colombia. By Simon Sarasola, S.J., Observatorio Nacional de San Bartolemé Bogota, 1924.

height. Hitherto the causes of bursting of balloons have remained obscure. The general impression amongst meteorologists is that bursting is due to abnormal distension of the balloon in the upper air. Owing to the reduction of external pressure, the rubber is stretched. The balloon, therefore, either suddenly bursts or develops one or more pin-holes and collapses.

It appears to the writer of this note that, hitherto, the effect of one of the most potent factors which determine the volume of the balloon at any stage of flight has been underestimated. This is the leakage of hydrogen through the balloon fabric. It has been pointed out by Mitchell and Graham that the diffusion of gases through rubber is an extremely complicated phenomenon. In actual flight the hydrogen leaks out of the pilot balloon and air leaks in. It should be noted, however, that the pressure gradient across the balloon fabric is continually disturbed owing to the wind, and pressure and temperature lapse in the free atmosphere. Owing to these reasons, the escape of hydrogen is probably six or seven times faster than the admission of air into the balloon.

A balloon having the ordinary free lift distends rapidly just at the beginning of the flight, but once it has survived this initial distension and attained a considerable height the net effect of all causes is probably a contraction instead of a distension. It appears, therefore, that the immediate causes of bursting at high levels should be sought in the tangential stresses due to shrinkage and other causes such as temperature lapse, direct solar radiation, resistance to upward motion, friction due to the rotational motion of the balloon and wind, especially when it is gusty.

When a balloon begins to contract, there is an excess of surface to be disposed of. This is probably automatically adjusted and the spherical shape of the balloon conserved if the inflation has not passed the safe limit and the tangential stresses are not too great for the fabric to bear. If, however, the stresses are of such magnitude that the spherical shape becomes untenable the balloon will burst. Observations of the lines of rupture in burst balloons indicate that just before the final collapse the spherical balloon probably passes through an intermediate stage in which it is an unstable tetrahedron or some analogous shape.

It is, therefore, suggested that balloons intended for high ascents should be made in the tetrahedral form. Before an ascent these balloons should be inflated with hydrogen to the spherical shape and given a high free lift consistent with the safe limit of inflation. In a balloon of this description any serious distortion under tangential stresses will tend to bring it back to its original shape before bursting, viz., the tetrahedron.

This intermediate stage, however, owing to the new process of manufacture, is stable and hence there will be better chances of the balloon surviving the ordeal than at present. Preliminary experiments in this direction may perhaps be carried out by reinforcing the ordinary balloon with rubber strips along the traces of a tetrahedron on a sphere. S. N. SEN.

Review

Correlation in Seasonal Variations of Weather, IX.—A further study of World-Weather. X.—Applications to seasonal forecasting in India. By Sir Gilbert T. Walker, C.S.I., F.R.S. Ind. Met. Mem., Vol. XXIV., 4to, $11\frac{3}{4} \times 9$. Part IX., pp. 275-332 and Part X., pp. 333-345. Calcutta, Superintendent Government Printing, 1924. Part IX., 4s. 9d. Part X., 9d.

IN 1923 Sir Gilbert Walker published a *Preliminary Study of World Weather** in which from a number of correlation coefficients between the pressure or rainfall in action centres in different parts of the world he drew certain conclusions as to the manner in which seasonal variations of weather are brought about. These researches have now been carried into greater detail, and in the first of the memoirs under consideration we are presented with a statistical basis for seasonal forecasting in nearly all parts of the world. The principle which guides the work is Hildebrandsson's well-known theory of " centres of action," according to which there are certain points—usually the centres of permanent areas of high or low pressure—which are the " strategic points of the world's weather " ; conditions at intermediate points are largely governed by these centres of action. The weather of the British Isles for example is largely governed by the intensity of the Icelandic low, the Azores high and, in winter, the central Siberian high. It has long been realised that there is some connection between the centres of action in different parts of the world, but until Sir Gilbert Walker began to publish his results, a measure of the connection was available in only a few instances.

The present memoir contains some four thousand correlation coefficients. Among so many, even if the data for different centres were entirely unrelated, chance agreements would produce a few large coefficients. Employing data for 20 years, the probable value of a random coefficient is 0·15, but of 17 random coefficients the probable value of the greatest is 0·46 ; thus one coefficient of this value among seventeen proves nothing. Everyone who attempts to deduce connections from large numbers of correlation coefficients would do well to study the

* Reviewed in *The Meteorological Magazine*, 59 (1924) 25.

opening remarks on this subject. Out of the 360 correlation coefficients between Iceland pressure and some other variable, only 19 are accepted as significant. It is satisfactory to notice, however, that the great majority of the significant coefficients occur according to plan, as laid down in part VIII.; this consistency "supports the view that seasonal forecasting is capable of wider application than at present." In many parts of the world the persistence of weather from one month to another is so great that quarterly forecasts would be of very great value, in other parts, such as the British Isles, the reversal of the pressure distribution from one month to another may be so complete that a unit of three months is too long, but even here quarterly forecasts would be useful as a base line on which fluctuations of shorter period could be superposed.

The second memoir (part X.) gives an example of the detailed application of the general results of part IX. to seasonal forecasting in India, and improved formulæ are deduced for calculating the monsoon rainfall in different districts, and the winter rain and snow of the north-west.

News in Brief

We regret to learn of the death on July 29th, at the age of 87, of Professor H. Hildebrand Hildebrandsson, late Director of the Meteorological Observatory at the University of Upsala.

We also regret to learn of the death of M. Calwagen of the Norwegian Meteorological Service, whose aeroplane crashed while he was making a flight for observation purposes at Kjeller near Oslo.

On Sunday, July 26th, at the meeting for gliders and light aeroplanes at Vauville (Manche), Captain Massaux (Belgium), flew in a Vivette glider for nearly 11 hours, thus beating the late M. Maneyrol's gliding record of 8 hrs. 15 min.

Staff News: Air Ministry Tennis Tournament, Ladies Doubles, winners Miss Geake and Miss Quennell; Ladies Singles, runner-up Miss Geake.

The Weather of July, 1925

At the beginning of the month the low pressure systems south of Iceland and over France broke through the ridge of high pressure spreading across England and brought to an end the drought which had lasted over 30 days in some south-western districts. A depression centred off the mouth of the Channel on the 2nd was associated with thunderstorms in several parts of England, and later, as it moved first east and then north, caused northerly winds and cooler, cloudy weather in the south-east counties.

Very little rain fell in the London area during the first half of the month except on the 6th-7th when a trough of low pressure approached from the Atlantic. After the 10th the anticyclone off Ireland began to spread across England and another spell of bright warm weather began. Temperature rose to about 80° F. in many instances and sunshine records exceeded 14 hours at some stations in the south-eastern counties. In the north and west, however, conditions were affected by depressions near Iceland which spread gradually southwards until by 17th a depression was centred over north-west Ireland, causing rain in many parts.

By the 21st the depression had moved southwards to the Bay of Biscay, temperatures rose again above 80° F. and thunderstorms of considerable intensity occurred in many parts. On the 22nd severe thunderstorms accompanied by heavy rain passed over the southern and midland districts in the early morning and again in the evening; 47 mm. (1·85 in.) were measured at Hampstead, and 50 mm. (1·97 in.) at Shennington Rectory, Oxfordshire. In the Woolwich and Plumstead districts of London extensive damage was done by hailstones.* The highest temperatures since the beginning of the year were recorded on this date, notably 86° F. at Kew Observatory and 91° F. at Lincoln.

The last week was marked by a cooler type of unsettled weather. Thunderstorms associated with heavy rain occurring locally. On the 25th 34 mm. (1·33 in.) fell in an hour at Llangynhafal in Denbighshire. A depression which passed across England from the Hebrides caused gales in the Channel on the 27th.

The rainfall during the first half of the month was well below the normal, except in some parts of Scotland and Ireland. The heavy falls during the latter part of the month have, however, brought the totals in most districts above the normal, some stations in south-east England recording more than twice the normal.

Pressure was above normal over most of the North Atlantic (including the Azores) and over Scandinavia, but the excess nowhere reached 5 mb. In the north of Scotland pressure was slightly above normal, but over the remainder of the British Isles, France and Switzerland, and also over Iceland, the Faroes and Spitsbergen, there was a deficit, exceeding 5 mb. at Isafjord. Temperature was above normal in Scandinavia and Spitsbergen, being 7° F. and 4° F. above normal in Lapland and Spitsbergen respectively. Rainfall was generally rather heavy and thunderstorms were numerous. Stormy weather prevailed in Italy during the first part of the month and a severe storm devastated

* See p. 169

the country near Messina, uprooting many trees and causing damage estimated at £30,000. On the 22nd there were violent thunderstorms in France; in Paris, nearly 10,000 telephones were put out of action and over the country considerable damage was done to crops by wind, rain and hail. About the same time heavy rain occurred in Bessarabia and Transylvania, and the crops, which had already suffered considerably from the drought, were in danger of being washed away. A violent thunderstorm, accompanied by very heavy rain and hail, broke over Amsterdam in the morning of the 28th. In Russia, while heavy rains were hampering the harvesting in the Ukraine and other districts, Kazan was suffering from intense heat. During the last 60 years, northern Sweden has never experienced so many thunderstorms in any one month as in this last July.

About the middle of the month intense heat prevailed in Canada and the United States. Temperatures of over 95° F. were reported from several parts of Canada, and 100° F. was exceeded in the Atlantic and Gulf States. In the west, still higher temperatures prevailed, 118° F. being recorded at Phœnix, Arizona, on the 16th. The heat wave broke up about the 20th and was followed in Canada by much-needed rain.

In the middle of the month, floods involving considerable loss of life were reported from Korea, the incessant rains causing the Rakuto River to burst its banks and inundate a large area. Thunderstorms accompanied by heavy rainfall occurred in Hong Kong, culminating with a fall of 254 mm. (10 in.) in 11 hours on the 17th. The heavy rains caused floods and landslides, and many lives were lost in the Chinese quarter of the City. Floods in the Khyber have carried away earthworks of the Pass railway.

The special message from Brazil states that the rainfall over the whole country was rather scanty, being 12 mm., 10 mm. and 41 mm. below normal in the northern, central and southern districts respectively. Anticyclones of greater intensity than in the previous few months passed across the country and a spell of unusually cold weather lasted during the greater part of the month in the central and southern districts. The tobacco, cotton and cane crops are suffering from the lack of rain but the wheat is doing well. At Rio de Janeiro the pressure was almost normal and the temperature 3·2° F. below normal.

Rainfall July, 1925—General Distribution

England and Wales ..	110	per cent. of the average 1881-1915.
Scotland	80	
Ireland	111	
British Isles	102	

Rainfall: July, 1925: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Lond.	Camden Square.....	3·58	91	150	*War.*	Birminghm, Edgbaston	3·19	81	137
Sur .	Reigate, Hartswood...	3·71	94	177	*Leics*	Thornton Reservoir ..	2·41	61	97
Kent.	Tenterden, View Tower	4·62	117	221	,, .	Belvoir Castle.....	1·79	45	74
,, .	Folkestone, Boro. San.	2·52	64	...	*Rut .*	Ridlington.....	2·17	55	...
,, .	Broadstairs, St. Peter's	2·41	61	116	*Linc.*	Boston, Skirbeck	1·04	26	47
,, .	Sevenoaks, Speldhurst.	4·20	107	...	,, .	Lincoln, Sessions House	·69	17	31
Sus .	Patching Farm.....	4·62	117	192	,, .	Skegness, Estate Office.	...	..	...
,, .	Brighton, Old Steyne .	4·21	107	203	,, .	Louth, Westgate	·45	11	18
,, .	Tottingworth Park....	5·21	132	208	,, .	Brigg	·79	20	34
Hants	Ventnor, Roy. Nat. Hos.	2·99	76	148	*Notts.*	Worksop, Hodsock....	2·30	58	101
,, .	Fordingbridge, Oaklnds	3·15	80	157	*Derby*	Mickleover, Clyde Ho..	1·78	45	73
,, .	Ovington Rectory	4·01	102	155	,, .	Buxton, Devon. Hos...	2·23	57	57
,, .	Sherborne St. John Rec.	2·80	71	126	*Ches.*	Runcorn, Weston Pt...	2·30	58	84
Berks	Wellington College...	3·77	96	182	,, ..	Nantwich, Dorfold Hall	2·42	61	...
,, .	Newbury, Greenham..	3·00	76	135	*Lancs*	Manchester, Whit. Pk.	1·98	50	60
Herts.	Bennington House....	3·52	89	...	,, ..	Stonyhurst College....	2·52	64	65
Bucks	High Wycombe	5·27	134	268	,, ..	Southport, Hesketh...	2·41	61	84
Oxf..	Oxford, Mag. College..	3·33	85	147	,, ..	Lancaster, Strathspey.	2·54	65	...
Nor .	Pitsford, Sedgebrook..	2·45	62	104	*Yorks*	Sedbergh, Akay	2·03	52	45
,, .	Eye, Northolm.....	1·92	49	...	,, .	Wath-upon-Dearne ...	1·30	33	52
Beds.	Woburn, Crawley Mill.	2·85	73	121	,, .	Bradford, Lister Pk...	1·06	27	39
Cam.	Cambridge, Bot. Gdns.	1·66	42	77	,, .	Wetherby, Ribston H..	2·00	51	80
Essex	Chelmsford, County Lab	4·19	107	197	,, .	Hull, Pearson Park ...	1·44	37	62
,, .	Lexden, Hill House...	1·84	47	...	,, .	Holme-on-Spalding ...	·96	24	...
Suff .	Hawkedon Rectory ...	1·09	28	45	,, .	West Witton, Ivy Ho..	1·21	31	...
,, .	Haughley House.....	·93	24	...	,, .	Felixkirk, Mt. St. John	2·02	51	74
Norf.	Beccles, Geldeston....	1·65	42	71	,, .	Pickering, Hungate ...	1·36	35	...
,, .	Norwich, Eaton	1·68	43	65	,, .	Scarborough.....	...	..	...
,, .	Blakeney	1·74	44	77	,, .	Middlesbrough	2·89	73	113
,, .	Swaffham	1·61	41	63	,, .	Baldersdale, Hury Res.	1·18	30	38
Wilts.	Devizes, Highclere....	3·69	94	159	*Durh.*	Ushaw College	1·74	44	62
,, .	Bishops Cannings	4·62	117	185	*Nor .*	Newcastle, Town Moor.	2·07	53	78
Dor .	Evershot, Melbury Ho.	3·01	77	119	,, .	Bellingham, Highgreen	1·85	47	...
,, .	Weymouth, Westham..	...	..	...	,, .	Lilburn Tower Gdns...	1·62	41	...
,, .	Shaftesbury, Abbey Ho.	2·82	72	110	*Cumb.*	Geltsdale.....	1·97	50	...
Devon	Plymouth, The Hoe...	2·86	73	103	,, .	Carlisle, Scaleby Hall .	2·20	56	67
,, .	Polapit Tamar	4·71	120	175	,, .	Seathwaite M.....	3·70	94	44
,, .	Ashburton, Druid Ho..	3·80	97	125	*Glam.*	Cardiff, Ely P. Stn.....	4·13	105	133
,, .	Cullompton	3·13	79	116	,, .	Treherbert, Tynywaun	4·78	121	...
,, .	Sidmouth, Sidmount ..	2·51	64	100	*Carm*	Carmarthen Friary....	2·49	63	71
,, .	Filleigh, Castle Hill ...	4·27	109	...	,, .	Llanwrda, Dolaucothy.	4·29	109	99
,, .	Barnstaple, N. Dev. Ath.	3·41	87	126	*Pemb*	Haverfordwest, School	2·72	69	...
Corn.	Redruth, Trewirgie ...	4·32	110	142	*Card.*	Gogerddan.....	2·78	71	72
,, .	Penzance, Morrab Gdn.	2·69	68	99	,, .	Cardigan, County Sch. .	3·85	98	...
,, .	St. Austell, Trevarna..	4·16	106	124	*Brec .*	Crickhowell, Talymaes	2·75	70	...
Soms	Chewton Mendip	5·61	143	161	*Rad .*	Birm. W. W. Tyrmynydd	3·30	84	80
,, .	Street, Hind Hayes ...	2·89	73	...	*Mont.*	Lake Vyrnwy	1·76	45	51
Glos..	Clifton College	3·47	88	123	*Denb.*	Llangynhafal	4·25	108	...
,, .	Cirencester	3·17	81	120	*Mer .*	Dolgelly, Bryntirion..	3·96	101	93
Here.	Ross, Birchlea	2·43	62	107	*Carn.*	Llandudno	2·89	73	21
,, .	Ledbury, Underdown.	2·50	63	111	,, .	Snowdon, L. Llydaw 9	9·05	230	...
Salop	Church Stretton.....	2·44	62	100	*Ang .*	Holyhead, Salt Island.	2·21	56	85
,, .	Shifnal, Hatton Grange	3·13	79	139	,, .	Lligwy	1·79	45	...
Staff.	Tean, The Heath Ho...	2·47	63	85	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	3·06	78	143		Douglas, Boro' Cem...	2·46	62	80
,, .	Blockley, Upton Wold.	3·53	90	145	*Guernsey*				
War.	Farnborough.....	4·64	118	181		St. Peter P't, Grange Rd	2·52	64	125

Rainfall: July, 1925: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	2·51	64	87	*Suth.*	Loch More, Achfary...	4·10	104	77
„ .	Pt. William, Monreith.	2·57	65	...	*Caith*	Wick	3·05	77	116
Kirk.	Carsphairn, Shiel.	2·66	68	...	*Ork .*	Pomona, Deerness	1·74	44	68
„ .	Dumfries, Cargen.....	2·04	52	63	*Shet .*	Lerwick	1·66	42	72
Dum	Drumlanrig	2·92	74	85					
Roxb	Branxholme	1·34	34	44	*Cork.*	Caheragh Rectory	4·12	105	...
Selk .	Ettrick Manse.....	1·84	47	...	„ ..	Dunmanway Rectory.	3·21	81	82
Berk.	Marchmont House	2·01	51	66	„ ..	Ballinacurra	2·72	69	97
Hadd	North Berwick Res....	1·42	36	55	„ ..	Glanmire, Lota Lo. ...	3·12	79	108
Midl	Edinburgh, Roy. Obs..	1·92	49	74	*Kerry*	Valencia Obsy.	4·01	102	106
Lan .	Biggar	2·05	52	71	„ .	Gearahameen	8·30	211	...
Ayr .	Kilmarnock, Agric. C..	2·63	67	85	„ .	Killarney Asylum.....	4·91	125	148
„ .	Girvan, Pinmore.....	2·49	63	68	„ .	Darrynane Abbey	5·25	133	138
Renf.	Glasgow, Queen's Pk..	1·71	43	59	*Wat .*	Waterford, Brook Lo..	2·41	61	74
„ .	Greenock, Prospect H..	2·23	57	57	*Tip .*	Nenagh, Cas. Lough...	2·87	73	91
Bute.	Rothesay, Ardencraig.	2·30	58	58	„ .	Tipperary	3·75	95	...
„ .	Dougarie Lodge	2·49	63	...	„ .	Cashel, Ballinamona ..	2·34	59	81
Arg .	Ardgour House	4·14	105	...	*Lim .*	Foynes, Coolnanes	4·13	105	134
„ .	Manse of Glenorchy..	3·42	87	...	„ .	Castleconnell Rec.	3·64	93	...
„ .	Oban	2·98	76	...	*Clare*	Inagh, Mount Callan ..	6·30	160	...
„ .	Poltalloch	4·29	109	105	„ .	Broadford, Hurdleat'n.	3·47	88	...
„ .	Inveraray Castle.....	3·97	101	80	*Wexf*	Newtownbarry	...	..	...
„ .	Islay, Eallabus.....	4·35	111	128	„ .	Gorey, Courtown Ho...	2·02	51	69
„ .	Mull, Benmore	8·30	211	...	*Kilk.*	Kilkenny Castle	2·28	58	81
Kinr.	Loch Leven Sluice	1·35	34	47	*Wic .*	Rathnew, Clonmannon	2·65	67	...
Perth	Loch Dhu	2·65	67	55	*Carl .*	Hacketstown Rectory .	3·82	97	111
„ ..	Balquhidder, Stronvar.	2·55	65	59	*QCo..*	Blandsfort House.....	2·36	60	75
„ ..	Crieff, Strathearn Hyd.	2·99	76	101	„	Mountmellick	...	..	...
„ ..	Blair Castle Gardens ..	2·38	61	93	*KCo.*	Birr Castle.....	3·96	101	134
„ .	Coupar Angus School..	2·83	72	120	*Dubl.*	Dublin, FitzWm. Sq...	2·65	67	104
Forf.	Dundee, E. Necropolis.	1·76	45	64	„ .	Balbriggan, Ardgillan .	3·11	79	115
„ .	Pearsie House.....	1·74	44	...	*Me'th*	Drogheda, Mornington	3·16	80	...
„ .	Montrose, Sunnyside..	2·05	52	78	„ .	Kells, Headfort.....	3·20	81	101
Aber.	Braemar, Bank	3·14	80	123	*W.M*	Mullingar, Belvedere .	2·86	73	90
„ .	Logie Coldstone Sch. ..	1·99	51	67	*Long*	Castle Forbes Gdns....	3·60	91	115
„ .	Aberdeen, Cranford Ho	...	..	...	*Gal .*	Ballynahinch Castle ..	7·98	203	192
„ .	Fyvie Castle	3·11	79	...	*Mayo*	Mallaranny.....	7·12	181	...
Mor .	Gordon Castle.....	4·00	102	125	„ .	Westport House.....	5·02	127	162
„	Grantown-on-Spey....	2·82	72	92	„ .	Delphi Lodge	8·09	205	...
Na .	Nairn, Delnies.....	1·90	48	71	*Sligo*	Markree Obsy.	3·92	100	114
Inv..	Ben Alder Lodge	1·83	47	...	*Cav'n*	Belturbet, Cloverhill..	3·76	95	120
„ .	Kingussie, The Birches	2·31	59	...	*Ferm*	Enniskillen, Portora ..	3·70	94	...
„ .	Loch Quoich, Loan....	5·00	127	...	*Arm.*	Armagh Obsy.	3·78	96	131
„ .	Glenquoich	3·76	95	59	*Down*	Warrenpoint	3·84	97	...
„ .	Inverness, Culduthel R.	2·32	59	...	„ .	Seaforde	4·77	121	150
„ .	Arisaig, Faire-na-Squir	3·19	81	...	„ .	Donaghadee, C. Stn...	2·15	55	77
„ .	Fort William.....	2·70	69	56	„ .	Banbridge, Milltown .	4·85	123	149
„ .	Skye, Dunvegan.....	4·19	106	...	*Antr.*	Belfast, Cavehill Rd. .	4·59	117	...
„ .	Barra, Castlebay	2·72	69	...	„ .	Glenarm Castle.....	2·28	58	...
R&C	Alness, Ardross Cas. ..	2·90	74	96	„ .	Ballymena, Harryville	4·49	114	131
„ .	Ullapool.....	2·67	68	...	*Lon .*	Londonderry, Creggan	3·67	93	100
„ .	Torridon, Bendamph..	3·60	91	66	*Tyr .*	Donaghmore	3·48	88	...
„ .	Achnashellach	3·15	80	...	„ .	Omagh, Edenfel	...		...
„ .	Stornoway	2·08	53	69	*Don .*	Malin Head	3·77	96	133
Suth.	Lairg	1·96	50	...	„ .	Rathmullen.....	4·70	119	...
„ .	Tongue Manse.....	2·74	70	90	„ .	Dunfanaghy	4·07	103	118
„ .	Melvich School.....	2·75	70	98	„ .	Killybegs, Rockmount.	4·32	110	98

Climatological Table for the British Empire, February, 1925

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1005·1	−10·9	54	29	47·6	37·7	42·7	+ 2·6	39·4	88	7·3	81	+ 42	17	2·1	22
Gibraltar	1021·3	+ 1·3	65	44	60·8	48·4	54·6	− 1·3	48·4	83	5·3	80	− 27	14	...	...
Malta	1019·0	+ 2·3	66	43	60·4	51·2	55·8	+ 0·5	50·7	78	5·1	29	− 27	9	6·2	57
Sierra Leone	1012·1	+ 1·1	97	67	90·0	72·8	81·4	− 0·9	74·2	72	3·5	0	− 7	0	...	...
Lagos, Nigeria	1009·5	− 0·6	92	72	89·6	75·1	82·3	+ 0·2	75·9	84	6·9	10	− 41	1	...	...
Kaduna, Nigeria	1014·7	+ 2·7	93	...	88·9	...	...	...	53·1	28	0·9	0	− 1	0	...	...
Zomba, Nyasaland	1008·7	0·0	83	62	79·8	65·4	72·6	+ 0·8	...	91	8·8	243	− 31	25	...	...
Salisbury, Rhodesia	1008·7	− 0·7	79	55	76·4	60·0	68·2	− 0·7	62·6	79	7·4	255	+ 73	20	5·7	45
Cape Town	1013·1	− 0·2	102	53	84·2	62·0	73·1	+ 2·6	63·9	74	2·5	5	− 8	3	...	...
Johannesburg	1012·7	+ 1·4	85	52	76·6	56·6	66·6	+ 1·2	59·5	77	5·6	112	− 18	8	7·7	59
Mauritius	1011·9	+ 0·9	89	68	85·6	71·6	78·6	− 0·7	73·9	67	5·7	24	−189	15	9·1	72
Bloemfontein	...	...	93	56	83·7	59·9	71·8	− 0·1	63·2	65	3·4	55	− 33	10	...	...
Calcutta, Alipore Obsy.	1012·5	− 0·8	89	52	82·2	59·3	70·7	− 0·3	69·3	84	3·4	6	− 22	1*	...	...
Bombay	1012·4	− 0·3	87	60	81·1	65·5	73·3	− 2·3	62·1	69	0·8	0	− 1	0*	...	...
Madras	1012·5	− 0·4	94	62	87·4	66·4	76·9	− 0·8	70·8	82	2·4	0	− 8	0*	...	...
Colombo, Ceylon	1010·4	− 0·7	91	63	87·4	71·1	79·3	− 0·4	74·6	69	4·8	178	+133	8	7·9	66
Hong Kong	1019·3	+ 0·6	71	40	60·4	52·5	56·5	− 2·6	50·8	69	7·7	10	− 31	6	4·1	26
Sandakan	...	...	87	71	85·3	74·5	79·9	− 0·2	76·1	86	...	388	+144	13	...	...
Sydney	1010·0	− 4·0	87	59	79·9	65·3	72·6	+ 1·4	66·7	60	5·0	49	− 63	9	8·4	63
Melbourne	1011·0	− 3·5	89	48	76·4	58·3	67·3	− 0·1	59·5	65	6·9	29	− 15	11	7·0	50
Adelaide	1012·2	− 2·1	95	53	80·7	60·5	70·6	− 3·5	61·1	53	6·7	155	+138	6	7·4	56
Perth, W. Australia	1010·4	− 2·6	98	51	82·1	60·5	71·3	− 2·8	62·0	54	3·9	6	− 6	4	9·6	73
Coolgardie	1010·6	− 1·9	101	51	84·5	59·5	72·0	− 4·0	59·7	53	4·3	94	+ 75	7	...	...
Brisbane	1010·3	− 2·2	106	64	86·6	70·2	78·4	+ 1·8	72·1	69	5·5	71	− 90	13	7·9	61
Hobart, Tasmania	1008·1	− 5·4	79	43	68·3	53·8	61·1	− 1·3	54·5	67	7·8	34	− 3	11	5·7	42
Wellington, N.Z.	1011·4	− 3·9	75	46	69·3	55·6	62·5	+ 0·1	57·4	65	5·3	99	+ 16	10	7·8	57
Suva, Fiji	1007·9	+ 0·2	91	70	88·4	72·3	80·3	− 0·2	76·5	79	5·3	210	− 47	18	...	...
Apia, Samoa	1009·6	+ 1·2	89	73	85·5	75·1	80·3	+ 1·3	77·4	76	5·8	169	−230	18	6·8	54
Kingston, Jamaica	1015·1	− 0·2	87	64	84·3	66·0	75·1	− 1·4	62·9	78	2·6	23	+ 8	5	...	...
Grenada, W.I.	1014·5	+ 1·1	85	68	82·4	70·9	76·7	− 0·3	71·7	72	4·9	32	− 40	7	...	...
Toronto	1016·5	− 1·5	50	2	33·9	20·9	27·4	+ 5·7	22·8	66	8·5	91	+ 25	16	3·4	33
Winnipeg	1018·6	− 3·2	41	−31	13·0	−4·5	4·3	+ 4·9	...	...	5·7	14	− 6	12	3·3	33
St. John, N.B.	1016·3	+ 2·2	49	−8	34·8	20·2	27·5	+ 7·6	23·6	73	7·4	76	− 23	18	3·7	36
Victoria, B.C.	1012·0	− 3·9	54	36	48·5	40·0	44·3	+ 4·0	40·2	89	8·0	61	− 29	17	2·7	27

* For Indian stations a rain day is a day on which 0·[illegible]in. (2·5 mm.) or more rain has fallen.

Victoria, B.C.	1012·0	— 3·9	54	36	48·5	40·0	44·3	+ 4·0	40·2	89	8·0	61	— 29	17	2·7	27

* For Indian stations a rain day is a day on which [illegible] in. (2·5 mm.) or more rain has fallen.